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STABILITY OF AIRPLANES.

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There is a very general misunderstanding about the amount of skill and natural aptitude required for flying an airplane. One often finds an impression among persons not directly associated with aeronautics or in a position to be kept informed of advances in that science that the operation of an airplane is somewhat analogous to walking a tight rope, and that the piloting of such machines is possible only for those who have the natural aptitudes of the trick bicycle rider or the aerial acrobat. As a matter of fact, of course, flying is extremely easy. In many ways it is easier than driving an automobile, and any sound person can learn to fly at least fairly well, if not to be a pilot of exceptional skill.

The popular misconception regarding the difficulty of flying arises largely from the belief that the airplane is an essentially unstable vehicle and that it is continually watching for a chance to get out of equilibrium and hurl its unwary pilot to his doom. While such strictures might have been justified, at least to a slight extent, in connection with some of the early aircraft, there is no reason for them now, as the modern commercial or touring airplane is extremely stable and steady in flight. It not only does not deliberately depart from its normal course but even resists any attempt to make it do so. In fact, some airplanes

* Taken from "The Christian Science Monitor."

are so stable that pilots object to them on the ground that it is impossible to make them fly in an abnormal position when that is necessary for the purposes of a particular maneuver.

Automatic Pilots.

Such stabilization does not require the use of any elaborate mechanical device. In the early days of flying all sorts of schemes, most of them involving pendulums and gyroscopes, were proposed and tried and some succeeded very well in stabilizing the airplane or at least in exercising the functions of the pilot, relieving him of the duty of operating the controls. It should be emphasized, however, that the mechanism merely operates the controls, and that no such thing as a true stabilizer, operating directly on the airplane as a gyroscopic stabilizer acts on a ship, has yet been produced. A real stabilizer, at least if it were of the gyroscopic type, would be far too heavy to be carried in flight. Some of the devices for keeping an airplane on an even keel are already described by their inventors as automatic pilots or mechanical pilots, rather than as stabilizers, and it would be well if the same terminology were to spread to all the other cases.

No automatic pilot has gained any real wide measure of favor. The difficulty of piloting is not great enough to require the intervention of any new devices, especially since they do not relieve the pilot of his most difficult task, that of making a landing. Pilots have a natural distrust of any new mechanism and hesitate to permit the introduction of an instrument, the multitudi-

nous gears and levers hidden away from inspection, on whose continued perfect functioning the pilot's life must hang. They far prefer to depend either on their own skill and watchfulness or on the natural stability of the airplane secured by the form and disposition of its rigid parts.

Stable Designs.

A skillful pilot can fly an unstable airplane successfully. Quite aside from this fact, however, there really is no need for elaborate mechanisms such as are frequently produced, as it is not difficult to make any desired degree of stability inherent in the aircraft, arising from the very design of the machine. In fact, the point has been reached where it is possible to lay down a few simple rules which suffice to insure stability, at least in longitudinal motions. To prevent pitching and to insure that it will not attain a dangerous magnitude is far easier than to prevent the airplane becoming unstable in roll. Although the most uncomfortable oscillations of an aircraft are those in pitch, the airplane being unlike a ship in this respect, there is little danger from such oscillations if the slightest attention was given to stability in the design.

Stability in roll, however, and the securing of directional stability, or the tendency to maintain a straight course and to resist any tendency to go into a turn, are much more difficult to secure and the problems connected with them are not yet fully understood. The most frequent cause of accident is still the spin,

a particular form of lateral instability. Airplanes have been built which were "spin-proof," which would never assume a spinning attitude of their own accord, but the means by which that much to be desired characteristic was obtained are not yet clear enough to make possible their certain duplication on another design.

Reliance in Mathematics.

The study of stability and its improvements on given types of airplanes is one of the most important in connection with which further study is required. Development in this direction can come only through the enthusiastic cooperation of the airplane designer, the experimenter in the laboratory or in free flight, and the mathematician to whom the theory of the subject is due. It cannot be too strongly emphasized to those who do not already know it that the whole procedure in designing stable aircraft is based on a mathematical theory originally produced by pure mathematicians and physicists, some of whom had never had the slightest experience in flight. That it is now possible to produce an airplane which can be flown for long periods without touching the control is due largely to the genius and patient labor of Professor Bryan and Dr. Leonard Bairstow and others in England and of Prof. E. B. Wilson and Commander Hunsaker and their colaborers in other countries.

Mathematical analysis alone, of course, does not suffice, and the practical application of mathematics must rest on data obtainable in part in the wind tunnel or laboratory, in part only in

flight. The most effective check on any deductions regarding stability is obtained by making a succession of changes in an airplane and actually observing the effect which they produce on stability. Such work has been and is being done by the Royal Aircraft Establishment in England and by the National Advisory Committee for Aeronautics here, and on it no less than on the labors of the mathematician the production of safe and stable machines in the future must rest.

The final problem is to secure the devoted cooperation of the airplane designer. It is a lamentable fact that there yawns too often a wide gulf between the "theorist" and the "practical man," a gulf across which each party regards the other with scorn. The problems are too great to permit of any dissension as to who shall work on them, and the best results will be obtained only when the designer makes full use of the work of the experimenter and the mathematician and when those individuals of more theoretical bent carry on their labors with the actual practical needs of the designer constantly in mind.